ANNEX 7 Uncertainty

The annual U.S. Inventory presents the best effort to produce estimates for greenhouse gas source and sink categories in the United States. These estimates were generated according to the UNFCCC reporting guidelines, following the recommendations set forth in the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC/UNEP/OECD/IEA 1997), the *IPCC Good Practice Guidance* (IPCC 2000), and the Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC 2003). This Annex provides an overview of the uncertainty analysis conducted to support the U.S. Inventory, describes the sources of uncertainty characterized throughout the Inventory associated with various source categories (including emissions and sinks), and describes the methods through which uncertainty information was collected, quantified, and presented.

7.1. Overview

Some of the current inventory estimates, such as those for CO_2 Emissions from Fossil Fuel Combustion for example, have a relatively low level of uncertainty associated with them. Other categories of emissions exist, however, for which the inventory emission estimates are considered less certain. The major types of uncertainty associated with these inventory estimates are (1) model uncertainty, which arises when the emission and/or removal estimation models used in developing the inventory estimates do not fully and accurately characterize the respective emission and/or removal processes (due to a lack of technical details or other resources), resulting in the use of incorrect or incomplete estimation methodologies and (2) parameter uncertainty, which arises due to a lack of precise input data such as emission factors and activity data.

The model uncertainty can be evaluated by comparing model results with those of other models developed to characterize the same emission (or removal) process and through sensitivity analysis. However, it would be very difficult—if not impossible—to quantify the model uncertainty associated with the inventory estimates (primarily because, in most cases, only a single model has been developed to estimate emissions from any one source). Therefore, model uncertainty was not quantified in this report. Nonetheless, it has been discussed qualitatively, where appropriate, along with the individual source category description and inventory estimation methodology

Parameter uncertainty is, therefore, the principal type and source of uncertainty associated with the national inventory estimates and is the main focus of the quantitative uncertainty analyses in this report. Parameter uncertainty has been quantified for most of the emission sources in the U.S. Inventory.

The primary purpose of the uncertainty analysis conducted in support of the U.S. Inventory is (i) to determine the quantitative uncertainty associated with the emission (and removal) estimates presented in the main body of this report [based on the uncertainty associated with the input parameters used in the emission (and removal) estimation methodologies] and (ii) to evaluate the relative importance of the input parameters in contributing to uncertainty in the associated source category inventory estimate and in the overall inventory estimate. Thus the U.S. Inventory uncertainty analysis provides a strong foundation for developing future improvements and revisions to the Inventory estimation process. For each source category, the analysis highlights opportunities for changes to data measurement, data collection, and calculation methodologies. These are presented in the “Planned Improvements” sections of each source category’s discussion in the main body of the report.

7.2. Methodology and Results

The United States has developed a QA/QC and uncertainty management plan in accordance with the IPCC *Good Practice Guidance*. Like the quality assurance/quality control plan, the uncertainty management plan is part of a continually evolving process. The uncertainty management plan provides for a quantitative assessment of the inventory analysis itself, thereby contributing to continuing efforts to understand both what causes uncertainty and how to improve inventory quality (EPA 2002). Although the plan provides both general and specific guidelines for implementing quantitative uncertainty analysis, its components are intended to evolve over time, consistent with the inventory estimation process. The U.S. plan includes procedures and guidelines, and forms and templates, for developing quantitative assessments of uncertainty in the national Inventory estimates.

The IPCC *Good Practice Guidance* recommends two approaches—Tier 1 and Tier 2—for developing quantitative estimates of uncertainty in the inventory estimate of individual source categories and the overall inventory. Of these, the Tier 2 approach is both more flexible and more powerful than Tier 1; both methods are described in the next section. The United States is currently in the process of implementing a multi-year strategy to develop quantitative estimates of uncertainty for all source categories using the Tier 2 approach. This year, which represents the third year of this process, a Tier 2 approach was implemented for all source categories except HCFC-22 production and CO_2 from natural gas flaring, and some Land Use, Land-Use Change and Forestry source categories.

The current Inventory reflects significant improvements over the previous publication in the extent to which the Tier 2 approach to uncertainty analysis was adopted. For the current Inventory, the Tier 1 approach was only adopted for one source category (i.e., HCFC-22 production), as compared to 10 source categories in the previous Inventory report. Each of the new Tier 2 analyses reflect additional detail and characterization of input parameters using statistical data collection, expert elicitation methods and more informed judgment. Quantitative uncertainty estimates were not calculated for CO_2 from Natural Gas Flaring (IPCC Source Category 1B2), although the emissions from this source have been included in the national Inventory estimate for 2004. Future efforts will be made to quantify uncertainty of this source category's emissions estimates using the Tier 2 approach. Emissions and sinks from International Bunker Fuels, Biomass Burning, and Indirect Greenhouse Gas Emissions are not included in total emissions estimated for the U.S. Inventory; therefore, no quantitative uncertainty estimates have been developed for these source categories.

Tier 1 and Tier 2 Approach

The Tier 1 method for estimating uncertainty is based on the error propagation equation. This equation combines the uncertainty associated with the activity data and the uncertainty associated with the emission (or the other) factors. The Tier 1 approach is applicable where emissions (or removals) are usually estimated as the product of an activity value and an emission factor or as the sum of individual sub-source category values. Inherent in employing the Tier 1 method are the assumptions that, for each source category, (i) both the activity data and the emission factor values are approximately normally distributed, (ii) the coefficient of variation associated with each input variable is less than 30 percent, and (iii) the input variables (i.e., values to be combined) are not correlated.

The Tier 2 method is preferred (i) if the uncertainty associated with the input variables are significantly large, (ii) if the distributions underlying the input variables are not normal, (iii) if the estimates of uncertainty associated with the input variables are significantly correlated, and/or (iv) if a sophisticated estimation methodology and/or several input variables are used to characterize the emission (or removal) process correctly. In practice, the Tier 2 is the preferred method of uncertainty analysis for all source categories where sufficient and reliable data are available to characterize the uncertainty of the input variables.

The Tier 2 method employs the Monte Carlo Stochastic Simulation technique (also referred to as the Monte Carlo method). Under this method, estimates of emissions (or removals) for a particular source category are generated many times (equal to the number of iterations specified) using an uncertainty model--which is an emission (or removal) estimation equation that simulates or is the same as the inventory estimation model for a particular source category. These estimates are generated using the respective, randomly-selected values for the constituent input variables using a simulation-software such as @RISK or Crystal Ball.

Characterization of Uncertainty in Input Variables

Both Tier 1 and Tier 2 uncertainty analyses require that all the input variables are well-characterized in terms of their distributions or PDFs. In the absence of particularly convincing data measurements, sufficient data samples, or expert judgments that determined otherwise, the PDFs incorporated in this year's source category uncertainty analyses were limited to uniform, triangular, lognormal, or normal. The choice among these four PDFs depended largely on the observed or measured data and expert judgment

Source Category Inventory Uncertainty Estimates

Discussion surrounding the input parameters and sources of uncertainty for each source category appears in the body of this report. Table A- 223 summarizes results based on assessments of source category-level uncertainty.

The table presents base year (1990 or 1995) and current year (2004) emissions for each source category. The combined uncertainty for each source category is expressed as a percent of the total 2004 emissions estimated for that source category. Source category trend uncertainty is subsequently described in this Annex.

Table A- 223: Summary Results of Source Category Uncertainty Analyses

Source Category	Base Year Emissions*	2004 Emissions	2004 Uncertainty	
	Tg CO_2 Eq.	Tg CO_2 Eq.	Low	High
CO_2	5,005.3	5,987.98		
Fossil Fuel Combustion	4,696.6	5,656.6	-1%	6%
Non-Energy Use of Fuels	117.2	153.4	-20%	8%
Natural Gas Flaring	5.8	6.0	NE	NE
Cement Manufacture	33.3	45.6	-13%	14%
Lime Manufacture	11.2	13.7	-8%	8%
Limestone and Dolomite Use	5.5	6.7	-7%	8%
Soda Ash Manufacture and Consumption	4.1	4.2	-7%	7%
Carbon Dioxide Consumption	0.9	1.2	-14%	14%
Waste Combustion	10.9	19.4	-15%	10%
Titanium Dioxide Production	1.3	2.3	-16%	16%
Aluminum Production	7.0	4.3	-30%	30%
Iron and Steel Production	85.0	51.3	-11%	45%
Ferroalloys	2.0	1.3	-3%	3%
Ammonia Production and Urea Application	19.3	16.9	-8%	8%
Phosphoric Acid Production	1.5	1.4	-18%	19%
Petrochemical Production	2.2	2.9	-14%	5%
Silicon Carbide Consumption	0.1	0.1	-17%	18%
Lead Production	0.3	0.3	-11%	11%
Zinc Production	0.9	0.5	-12%	13%
Land-Use Change and Forestry (Sink)[a]	*(910.4)*	*(780.1)*		
International Bunker Fuels[b]	*113.5*	*94.5*		
Biomass Combustion[b]	*216.7*	*211.2*		
CH_4	618.1	556.7		
Stationary Sources	7.9	6.4	-26%	94%
Mobile Sources	4.7	2.9	-8%	4%
Coal Mining	81.9	56.3	-4%	4%
Abandoned Coal Mines	6.0	5.6	-18%	23%
Natural Gas Systems	126.7	118.8	-29%	31%
Petroleum Systems	34.4	25.7	-33%	141%
Petrochemical Production	1.2	1.6171	-8%	6%
Silicon Carbide Production	+	+	-10%	10%
Iron and Steel Production	1.3	1.0	-7%	9%
Enteric Fermentation	117.9	112.6	-11%	18%
Manure Management	31.2	39.4	-18%	20%
Rice Cultivation	7.1	7.6	-67%	157%
Agricultural Residue Burning	0.7	0.9	-75%	96%
Landfills	172.3	140.9	-36%	16%
Wastewater Treatment	24.8	36.9	-33%	39%
International Bunker Fuels[b]	*0.2*	*0.1*		
N_2O	394.9	386.7		
Stationary Sources	12.3	13.7	-24%	188%
Mobile Sources	43.5	42.8	-16%	29%
Adipic Acid	15.2	5.7	-45%	44%
Nitric Acid	17.8	16.6	-16%	17%
Manure Management	16.3	17.7	-16%	24%
Agricultural Soil Management	266.1	261.5	-82%	82%
Agricultural Residue Burning	0.4	0.5	-73%	85%
Human Sewage	12.9	16.0	-75%	89%
N_2O Product Usage	4.3	4.8	-7%	7%
Waste Combustion	0.5	0.5	-73%	157%
Settlements Remaining Settlements	5.6	6.4	-84%	349%
Forest Land Remaining Forest Land	0.1	0.4	-96%	483%

International Bunker Fuels[b]	*1.0*	*0.9*		
HFCs, PFCs, and SF_6	114.5	143.2		
Substitution of Ozone Depleting Substances	24.1	103.3	-13%	20%
Aluminum Production (CF_4)	16.2	2.4	-10%	12%
Aluminum Production (C_2F_6)	2.2	0.4	-16%	18%
HCFC-22 Production	35.0	15.6	-10%	10%
Semiconductor Manufacture[c]	2.9	5.0	-23%	23%
Electrical Transmission and Distribution	28.6	13.8	-13%	13%
Magnesium Production and Processing	5.4	2.7	-11%	13%
Total	6,132.7	7,074.7		
Net Emission (Sources and Sinks)	5,222.3	6,294.6		

*Base Year is 1990 for all sources except Substitution of Ozone Depleting Substances, for which the United States has chosen to use 1995.
+ Does not exceed 0.05 Tg CO_2 Eq.
[a] Sinks are only included in net emissions total.
[b] Emissions from International Bunker Fuels and Biomass Combustion are not included in totals.
[c] For the purposes of this uncertainty analysis, emissions from Semiconductor Manufacture presented here differ from those reported in the national totals. This was done to reflect that the uncertainty analysis was based on the individual gases, such as NF_3, rather than on an analysis on the total mix of gases for this source.
Note: Totals may not sum due to independent rounding.

Overall (Aggregate) Inventory Uncertainty Estimate

The overall uncertainty estimate for the U.S. greenhouse gas emissions inventory was developed using the IPCC Tier 2 uncertainty estimation methodology. For each source category, the Monte Carlo simulation output data, which were generated during its quantitative uncertainty analysis, were used to fit an appropriate probability distribution. If such detailed output data were not available for particular emissions sources, individual probability distributions were assigned to those source category emission estimates based on the most detailed output statistics available from the quantitative uncertainty analysis performed.

For the HCFC production source category, only Tier 1 uncertainty results were used in the overall uncertainty analysis estimation. However, for all other emission sources (excluding international bunker fuels, CO_2 from biomass combustion, land-use change and forestry source and sink categories, and natural gas flaring), Tier 2 uncertainty results were used in the overall uncertainty estimation.

The results from the overall uncertainty model indicate that the 2004 U.S. greenhouse gas emissions are estimated to be within the range of approximately 6,967 to 7,519 Tg of CO_2 equivalent emissions reflecting a relative 95 percent confidence interval uncertainty range of -2 percent to 6 percent with respect to the total U.S. greenhouse gas emissions estimate of about 7,075 Tg CO_2 Eq. The uncertainty interval associated with the total CO_2 emissions, which constitute about 85% of the total U.S. greenhouse gas emissions in 2004, ranges from about -1 percent to about 6 percent of the total CO_2 emissions estimated. The results indicate that the uncertainty associated with the inventory estimate of the total N_2O emissions is the largest (-39 percent to 48 percent), followed by the total inventory CH_4 emissions (±11 percent) and high GWP gas emissions (-9 percent to 15 percent).

A summary of the overall quantitative uncertainty estimates are shown below, in Table A- 224.

Table A- 224. Quantitative Uncertainty Assessment of Overall National Inventory Emissions (Tg CO_2 Eq. and Percent)

Gas	2004 Emission Estimate (Tg CO_2 Eq.)	Uncertainty Range Relative to Emission Estimate[a] (Tg CO_2 Eq.)		(%)		Mean[b] (Tg CO_2 Eq.)	Standard Deviation
		Lower Bound[c]	Upper Bound[c]	Lower Bound[c]	Upper Bound[c]		
CO_2	5,988.0	5,920.5	6,329.8	-1%	6%	6,120.6	105.3
CH_4	556.7	495.3	620.2	-11%	11%	556.5	31.8
N_2O	386.7	235.1	571.5	-39%	48%	403.1	88.3
PFC, HFC & SF_6[d]	143.2	130.1	164.8	-9%	15%	147.2	8.9
Total	7,074.7	6,966.8	7,518.9	-2%	5%	7,245.2	142.2

Notes:
[a] Range of emission estimates for a 95 percent confidence interval.
[b] Mean value indicates the arithmetic average of the simulated emission estimates; Standard deviation indicates the extent of deviation of the simulated values from the mean.
[c] The low and high estimates for total emissions were separately calculated through simulations and, hence, the low and high emission estimates for the sub-source categories do not add up to total emissions.

[d] The overall uncertainty estimate did not take into account the uncertainty in the GWP values for CH_4, N_2O and high GWP gases used in the inventory emission calculations for 2004.

Trend Uncertainty

In addition to the estimates of uncertainty associated with the current year's emission estimates, this Annex also presents estimates of trend uncertainty. The *IPCC Good Practice Guidance* defines trend as the difference in emissions between the base year (i.e., 1990 or 1995) and the current year (i.e., 2004) inventory estimates. However, for purposes of understanding the concept of trend uncertainty, the emission trend is defined in this report as the percentage change in the emissions (or removal) estimated for the current year, relative to the emission (or removal) estimated for the base year. The uncertainty associated with this emission trend is referred to as *trend uncertainty*.

Under the Tier 1 approach, the trend uncertainty for a source category is estimated using the sensitivity of the calculated difference between base year and 2004 emissions to an incremental (i.e., 1 percent) increase in one or both of these values for that source category. The two sensitivities are expressed as percentages: Type A sensitivity highlights the effect on the difference between the base and the current year emissions caused by a 1 percent change in both, while Type B sensitivity highlights the effect caused by a change to only the current year's emissions. Both sensitivities are simplifications introduced in order to analyze correlation between base and current year estimates. Once calculated, the two sensitivities are combined using the error propagation equation to estimate overall trend uncertainty.

Under the Tier 2 approach, the trend uncertainty is estimated using Monte Carlo Stochastic Simulation technique. The trend uncertainty analysis takes into account the fact that the base and the current year estimates often share input variables. For purposes of the current Inventory, a simple approach has been adopted, under which the base year source category emissions (or removals) are assumed to exhibit the same uncertainty characteristics as the current year emissions (or removals). Source category-specific PDFs for the base year estimates were developed using the 2004 uncertainty output data. These were adjusted to account for differences in magnitude between the the base and the current years' inventory estimates. Then, for each source category, a trend uncertainty estimate was developed using the Monte Carlo method. The overall inventory trend uncertainty estimate was developed by combining all source category-specific trend uncertainty estimates. These preliminary trend uncertainty estimates present the range of likely change from base year to 2004, and are shown in Table A- 225.

Table A- 225. Quantitative Assessment of Trend Uncertainty (Tg CO_2 Eq. and Percent)

Gas/Source	Base Year* (Tg CO_2 Eq.)	2004 (Tg CO_2 Eq.)	Emissions Trend (%)	Trend Range[a] (%) Lower Bound	Trend Range[a] (%) Upper Bound
CO_2	5,005.3	5,988.0	20%	14%	25%
Fossil Fuel Combustion	4,696.6	5,656.6	20%	14%	26%
Non-Energy Use of Fuels	117.2	153.4	31%	5%	64%
Natural Gas Flaring	5.8	6.0	4%		
Cement Manufacture	33.3	45.6	37%	12%	66%
Lime Manufacture	11.2	13.7	22%	9%	37%
Limestone and Dolomite Use	5.5	6.7	21%	9%	35%
Soda Ash Manufacture and Consumption	4.1	4.2	2%	-9%	13%
Carbon Dioxide Consumption	0.9	1.2	38%	12%	68%
Waste Combustion	10.9	19.4	77%	48%	112%
Titanium Dioxide Production	1.3	2.3	73%	37%	119%
Aluminum Production	7.0	4.3	-38%	-60%	-6%
Iron and Steel Production	85.0	51.3	-40%	-57%	-15%
Ferroalloys	2.0	1.3	-35%	-38%	-32%
Ammonia Production and Urea Application	19.3	16.9	-12%	-22%	-2%
Phosphoric Acid Production	1.5	1.4	-9%	-30%	18%
Petrochemical Production	2.2	2.9	30%	8%	44%
Silicon Carbide Consumption	0.1	0.1	33%	3%	71%
Lead Production	0.3	0.3	-9%	-23%	6%
Zinc Production	0.9	0.5	-47%	-56%	-36%
Land-Use Change and Forestry (Sink)[b]	*(910.4)*	*(780.1)*	0%		
International Bunker Fuels[c]	*113.5*	*94.5*	0%		

Biomass Combustion[c]	*216.7*	*211.2*	0%		
CH_4	618.1	556.7	-10%	-25%	4%
Stationary Sources	7.9	6.4	-18%	-61%	73%
Mobile Sources	4.7	2.9	-38%	-52%	-43%
Coal Mining	81.9	56.3	-31%	-35%	-27%
Abandoned Coal Mines	6.0	5.6	-6%	-30%	26%
Natural Gas Systems	126.7	118.8	-6%	-40%	46%
Petroleum Systems	34.4	25.7	-26%	-76%	52%
Petrochemical Production	1.2	1.6	39%	24%	52%
Silicon Carbide Production	0.0	0.0	-67%	-71%	-62%
Iron and Steel Production	1.3	1.0	-21%	-29%	-11%
Enteric Fermentation	117.9	112.6	-4%	-22%	17%
Manure Management	31.2	39.4	26%	-3%	67%
Rice Cultivation	7.1	7.6	6%	-75%	351%
Agricultural Residue Burning	0.7	0.9	27%	-70%	448%
Landfills	172.3	140.9	-18%	-46%	24%
Wastewater Treatment	24.8	36.9	49%	-10%	150%
International Bunker Fuels[c]	*0.2*	*0.1*	-36%		
N_2O	394.9	386.7	-2%	-48%	86%
Stationary Sources	12.3	13.7	11%	-60%	222%
Mobile Sources	43.5	42.8	-1%	-35%	20%
Adipic Acid	15.2	5.7	-62%	-81%	-24%
Nitric Acid	17.8	16.6	-7%	-26%	18%
Manure Management	16.3	17.7	9%	-17%	46%
Agricultural Soil Management	266.1	261.5	-2%	-66%	206%
Agricultural Residue Burning	0.4	0.5	39%	-66%	481%
Human Sewage	12.9	16.0	24%	-71%	414%
N_2O Product Usage	4.3	4.8	11%	0%	24%
Waste Combustion	0.5	0.5	10%	-77%	532%
Settlements Remaining Settlements	5.6	6.4	15%	-90%	1145%
Forest Land Remaining Forest Land	0.1	0.4	556%	-38%	6527%
International Bunker Fuels[c]	*1.0*	*0.9*	-12%		
HFCs, PFCs, and SF_6	114.5	143.2	25%	12%	46%
Substitution of Ozone Depleting Substances	24.1	103.3	328%	241%	438%
Aluminum Production (CF_4)	16.2	2.4	-85%	-87%	-82%
Aluminum Production (C_2F_6)	2.2	0.4	-81%	-85%	-76%
HCFC-22 Production	35.0	15.6	-55%	-61%	-49%
Semiconductor Manufacture[d]	2.9	5.0	69%	15%	125%
Electrical Transmission and Distribution	28.6	13.8	-52%	-60%	-42%
Magnesium Production and Processing	5.4	2.7	-50%	-58%	-41%
Total	6,132.7	7,074.7	15%	8%	21%

*Base Year is 1990 for all sources except Substitution of Ozone Depleting Substances, for which the United States has chosen to use 1995.
+ Does not exceed 0.05 Tg CO_2 Eq.
[a] Trend Range represents the 95% confidence interval for the change in emissions from Base Year to 2004.
[b] Sinks are only included in net emissions total.
[c] Emissions from International Bunker Fuels and Biomass Combustion are not included in totals.
[d] For the purposes of this uncertainty analysis, emissions from Semiconductor Manufacture presented here differ from those reported in the national totals. This was done to reflect that the uncertainty analysis was based on the individual gases, such as NF3, rather than on an analysis on the total mix of gases for this source.
Note: Totals may not sum due to independent rounding.

7.3. Planned Improvements

Identifying the sources of uncertainty in the emission and sink estimates of the Inventory and quantifying the magnitude of the associated uncertainty is the crucial first step towards improving those estimates. Quantitative assessment of the parameter uncertainty may also provide information about the relative importance of input parameters (such as activity data and emission factors), based on their relative contribution to the uncertainty within the source category estimates. Such information can be used to prioritize resources with a goal of reducing uncertainty over time within or among inventory source categories and their input parameters. In the current Inventory, potential sources of model uncertainty have been identified for some emission sources, and preliminary uncertainty estimates based on their parameters' uncertainty have been developed for most of the emission source categories.

Specific areas that require further research include:

- *Incorporating excluded emission sources.* Quantitative estimates of the uncertainty associated with some of the sources and sinks of greenhouse gas emissions are not available at this time. In the future, efforts will focus on developing uncertainty estimates for all source categories for which emissions or removals are estimated.

- *Improving the accuracy of emission factors.* Further research is needed in some cases to improve the accuracy of emission factors used to calculate emissions from a variety of sources. For example, the accuracy of current emission factors applied to CH_4 and N_2O emissions from stationary and mobile combustion are highly uncertain.

- *Collecting detailed activity data.* Although methodologies exist for estimating emissions for some sources, problems arise in obtaining activity data at a level of detail in which aggregate emission factors can be applied. For example, the ability to estimate emissions of SF_6 from electrical transmission and distribution is limited due to a lack of activity data regarding national SF_6 consumption or average equipment leak rates.

In improving the quality of uncertainty estimates, the following areas deserve further attention:

- *Refine Source Category and Overall Uncertainty Estimates.* For many individual source categories, further research is needed to more accurately characterize PDFs that surround emissions modeling input variables. In some cases, this might involve using measured or published statistics rather than relying on expert judgment if such data are available.

- *Include GWP uncertainty in the estimation of Overall level and trend uncertainty.* The current year's Inventory, does not include the uncertainty associated with the GWP values in the estimation of the overall uncertainty for the Inventory. Including this source would contribute to a better characterization of overall uncertainty and help assess the level of attention that this source of uncertainty warrants in the future.

- *Improve characterization of trend uncertainty associated with the base year Inventory estimates.* Improve characterization of the base year uncertainty estimates in order to improve the analysis of trend uncertainty, to replace the simplifying assumptions described in the "Trend Uncertainty" section above.

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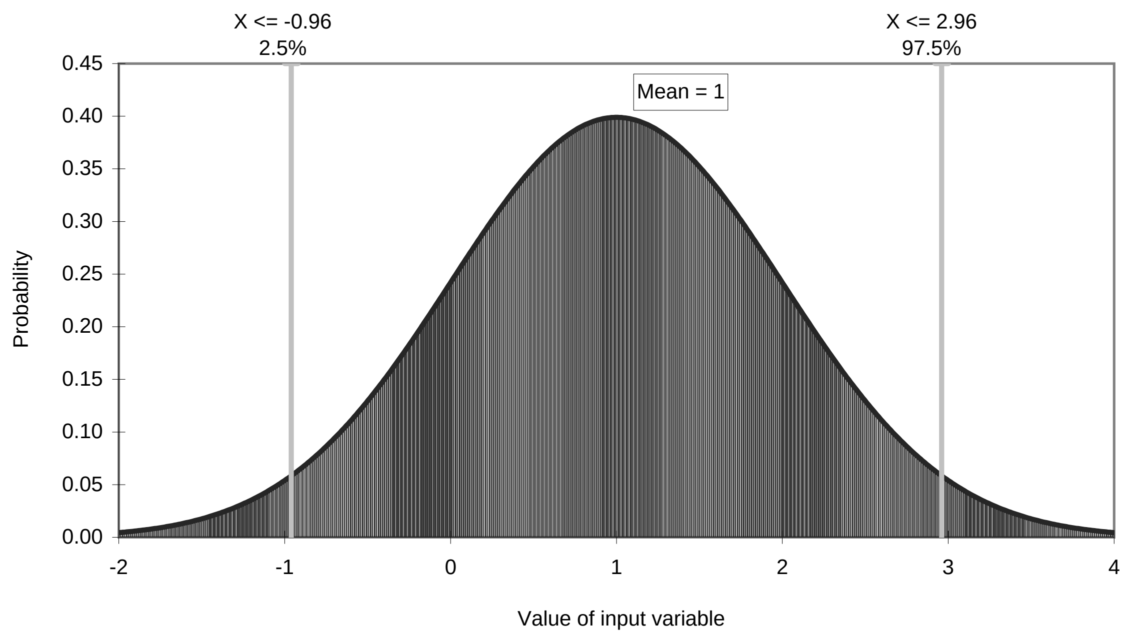

Figure A-11: Example of a Normal Distribution

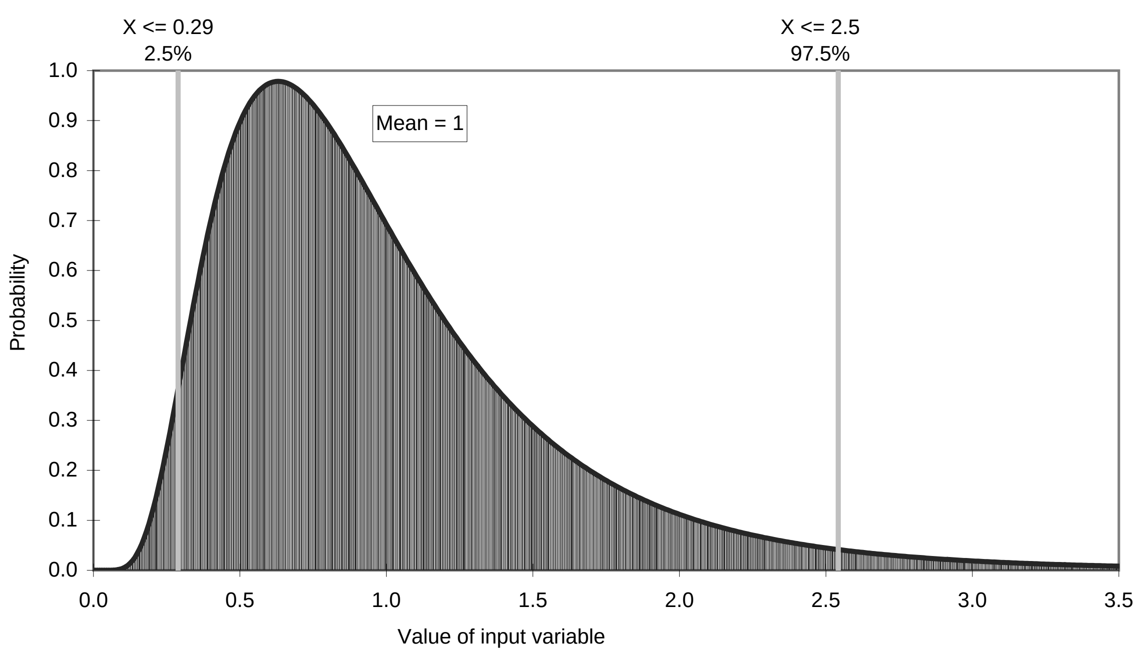

Figure A-12: Example of a Lognormal Distribution

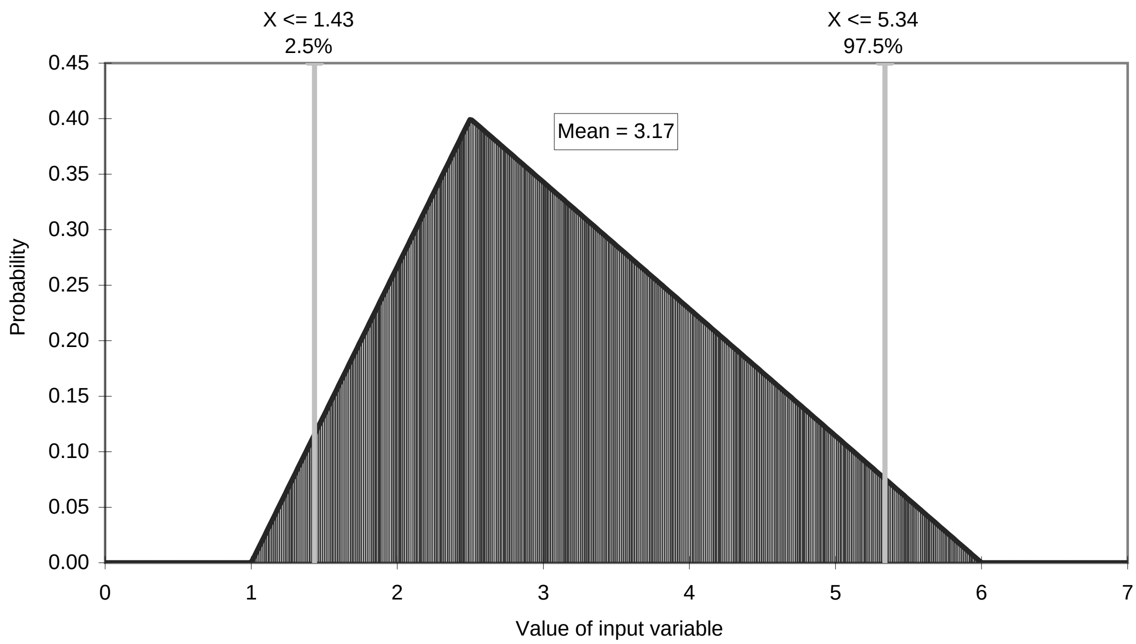

Figure A-13: Example of a Triangular Distribution

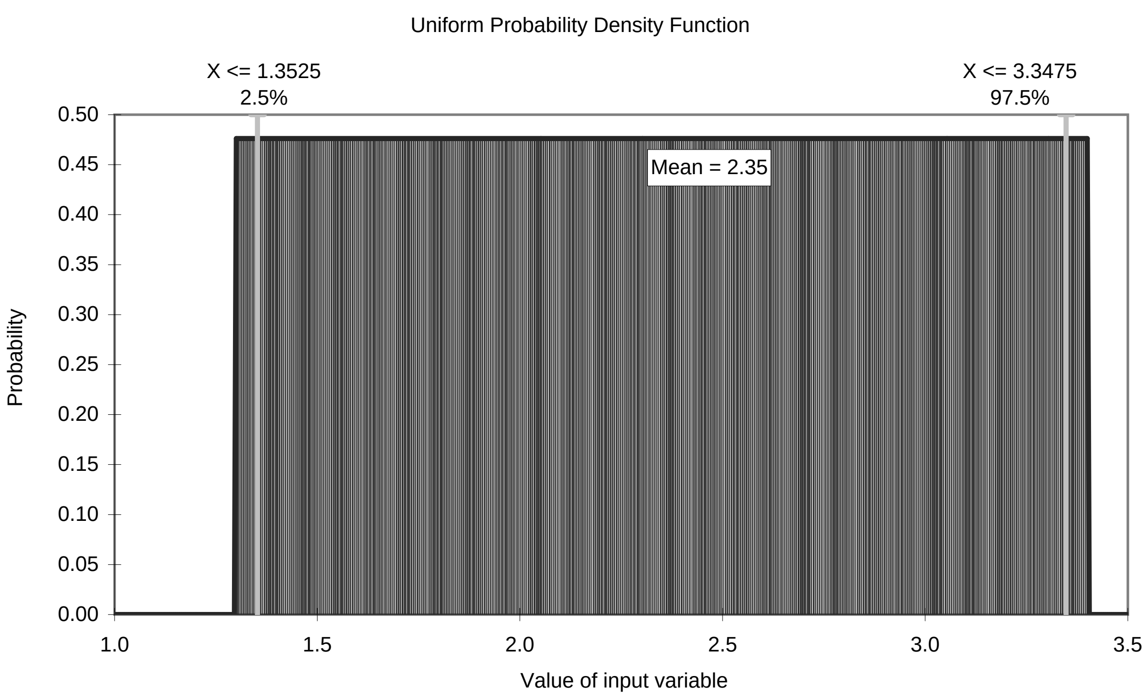

Figure A-14: Example of a Uniform Distribution

Descriptions of Figures: Annex 7

Figure A-11 illustrates a normal distribution. For a full description of a normal distribution, refer to the annex text.

Figure A-12 illustrates a lognormal distribution. For a full description of a lognormal distribution, refer to the annex text.

Figure A-13 illustrates a triangular distribution. For a full description of a triangular distribution, refer to the annex text.

Figure A-14 illustrates a uniform distribution. For a full description of a uniform distribution, refer to the annex text.